

NSLS-II Science Advisory Committee Meeting

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Report

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The autumn 2016 NSLS-II SAC meeting focused on three main topics

- Facility Operations and Strategic Planning
- Beamline Development
- User Program

and included exchange with NSLS-II staff (Accelerator RF Group, Accelerator Vacuum Group, ESH Group, Beamline staff).

The SAC members congratulate the NSLS-II team and staff for the quick ramp-up of user operation. The facility made rapid progress in most aspects of user operation. Key Performance Indicators (KPIs) for

- accelerator performance
- beamline construction
- user operation

have been reached or surpassed. Most notably, the NEXT & ABBIX projects are nearly finished now and the science program develops rapidly. In more detail, 400 mA ring current have been stored successfully, while routine operation at 250 mA in top-off mode with a reliability >90% has been established in FY16. 16 Beamlines are taking proposals with already about 470 unique users in FY16. The beamline development program progresses according to plan. These are remarkable achievements for only two years of operation, considering in particular the constant pressure on budget and the delicate competing demands to be balanced (operations, maintenance, commissioning of beamlines, further improvements of accelerator performance). The SAC members were happy to note that 22 beamlines are expected to be in service by the end of FY17, but also regretted the fact that realistic budget scenarios would not allow to develop new beamlines in FY18.

Concerning **Facility Operations and Strategic Planning**, the SAC was asked to comment on the following questions:

1. Is the current strategic planning process on track to produce a workable plan? What else should we be doing to develop an actionable plan?

The SAC is very happy to see a process for the development of a strategic plan. The different timelines are well chosen. Regular strategic retreats are an important tool for getting input from all parts of the facility. The capacity for following a strategic line has strongly increased in recent years. Aspects of the user program are under-represented in the strategic planning and should be worked out in more detail. It is important to develop a sustainable plan for staff-driven research and career development for scientists, i.e. finding the right balance between technical development, user support, science program. Beamline staff must have the opportunity to develop a profile as independent scientists in order to maintain the positions attractive for high-profile candidates. The development of an in-house research programme could be an important step in this direction. Concerning detectors, SAC feels that efforts for the development of detectors for high energy applications should be led by APS.

2. Are there other accelerator improvement options that we should be considering?
At the moment the lab goal is to reach 500-mA operation with numerous new insertion devices in operation within the next 2 years. For this to happen, a third active SC RF system (including transmitter and RF transmission system) is needed and the heating of ceramic vacuum chambers for the ring injection kickers needs to be reduced. Considering the constraints in resources (financial and human), the current upgrade to 500 mA is considered to be a lower priority by the SAC. Given the cost of reaching 500-mA operation, the SAC recommends that the facility reconsiders its development priorities if sacrifices are to be made. The SAC members believe that more effective progress might be made by limiting beam current to 350 mA, avoiding the cost of RF and harmonic cavity upgrades (other than to have a spare RF cavity) if sufficient resources are not available. Under such a scenario a focus on beamline development with reliable, stable beam would promise bigger returns.
3. Is the mix between operating hours, studies time, and commissioning optimal?
Overall the mix to meet the competing demands for accelerator demands, beamline development and user operation is reasonable and well-balanced. The distribution seems to be well adapted to satisfy the needs for rapid beamline development (science commissioning).
4. Is the strategic plan for life sciences well-formed and actionable? Are the opportunities identified appropriate to pursue and is the path outlined workable? Are there other opportunities not included that we should be pursuing?
In general, the plan is well-formed with a bold vision. It is the right strategy to get the biology department of BNL on board in order to develop an integrative, multi-model, and multiscale approach for biological samples. The quantitative plant science initiative is a good example and should be pursued further. How much of the plan will be actionable depends on the ability to tap into programs aligned with priorities of funding agencies. An area of particular concern is cryo-EM. A rapid start of activities in cryo-EM is mandatory to stay competitive on the national and international level. Cryo-EM is progressing very rapidly.
On an operational level, SAC was happy to learn that three access modes are being implemented: (i) joint SANS-SAXS applications for access to LiX and the ORNL neutron scattering beamlines, (ii) Block allocations for groups of scientists using Structural

Biology beamlines, and (iii) Rapid access to Structural Biology beamlines. The SAC noted, however, that progress on the beamlines is hampered by the lack of an adequate level of controls software support and that problems with bandwidth and CPU access occur when two MX beamlines work at the same time. SAC noted also that no dedicated bioXAS is available now, but might be developed on XFP. It would probably be best to find a super-user for spectroscopy to help rally the community.

5. Is our initial thinking in regard to the APS shutdown along the right lines? Are there other planning actions that we should be taking at this time in this regard?

The initial thoughts presented by the management are going in the right direction. The projected APS shutdown in the 2021/2022 provides an opportunity to leverage resources for beamline development at NSLS-II. An extended shutdown of the APS will affect a large part of the US photon science community and could provide the key argument for the further (rapid) development of the scientific capacities (beamline portfolio) at the NSLS-II. The SAC suggests that, concerning the response to user needs, the APS should drive it. This would follow the strategy adopted for the NSLS users during the dark period at BNL. An area to start with could be Life Science. There is definitely a capacity issue for macromolecular crystallography during the APS shutdown. This can only be dealt with in a coordinated approach between the facilities: how much do you really need and would this be an opportunity to create additional capacity at the NSLS-II.

Concerning the **NSLS-II Beamline Development**, the SAC was asked to comment on the following questions:

6. Is the NSLS-II overall strategy reasonable and justified given the revised funding guidance?

The overall strategy concerning the initial 29 beamlines is still sound. The initial beamlines need continued support even though projects might already be considered officially closed. An area where this becomes most apparent is controls. Controls remain an important issue to be addressed immediately in a sustainable way (SAC does not believe that one-year contracts will solve the problems (see also point 5 and 10).

7. Is the NSLS-II approach to developing additional beamlines with operations funds appropriate? Are the priorities correct?

Given the funding projections there seem to be no resources for the development of additional beamlines (gaping hole in FY18/FY19). The SAC reiterates the concerns expressed already at the previous SAC meeting about delays in the ramp-up of the science program induced by delays in beamline construction due to the lack of adequate resources on the floor. Spreading available resources too thin for the benefit of new projects might jeopardize the science program on the initial 29 beamlines and leave the user with a negative experience.

8. Is the accelerated approach on the Beamlines developed by NSLS-II (BDN) correctly prioritized?

This is a cost-effective approach that brings on capacity as rapidly as possible.

9. Are there other potential funding opportunities that we should be pursuing?

The SAC is fully aware of the stress in the DoE system and supports the BNL/NSLS-II management strategy to try to tap alternative funding sources, such as private foundations. This might help to fund construction of new beamlines/facilities for users, but might not be a sustainable source for funding operation. The most promising route to additional funding is probably through other agencies, such as the NNSA, which might be interested to fund targeted projects for their mission (MRE beamline together with BNL partners).

Concerning the **User Program**, the SAC was asked to comment on the following questions:

10. Are each of the initial beamlines on track to develop world-leading programs? If not, what should be done?

The SAC received updates from beamline scientists from each of the six facility beamlines, all of which are supporting some user operation at this time. SAC considers that the six initial beamlines collectively have done an excellent job of developing capabilities up to this point. Each beamline aims to represent state-of-the-art, and there have been strong efforts to bring cutting-edge facilities online in order to capitalize on the advantage that they have at this point in time. SAC additionally observes that each of these initial beamlines requires continuing strong support in order to bring the complete suite of techniques into full operational status. This support must be weighted carefully with the support that is needed to move ahead with the next wave of beamlines.

11. Is the mix between commissioning new capabilities and running a user program on each of the initial beamlines right?

All beamlines still have a mixture of user operation for the initially commissioned capabilities, with some development and commissioning of more advanced capabilities conducted during the same user cycle. SAC strongly endorses the approach that each beamline employs a unique mix of commissioning and user activities that reflects the state of the development of that specific facility. SAC notes that in addition to scheduling ahead, some flexibility in scheduling on the level of individual experiments might be required in order to fix problems that are uncovered after user programs are underway. The cross-talk between CSX-1 and CSX-2 is an example of that, in that rather than allowing users to come to the facility for beamtime and then to find out that the energy could not be varied, perhaps time could have been taken earlier to fix it. The SAC also recommends that there is communication with the users prior to the scheduled beamtime to alert them to any potential difficulties or restrictions.

12. Is the user program on the respective beamlines looking healthy for this point in their development?

The SAC believes that the user program on the respective beamlines is looking very good at this point, and commends the beamline staff for their strong efforts in this regard. SAC recognizes the strong commitment that is required from the beamline personnel at this point in development. As was observed, much more effort is required from beamline personnel in preparing users, assisting with their experiments, and consulting on data analysis since so many aspects of the technology, both hardware and software, is new.

Essentially each user group needs to be treated as “new”, even if they have been working in this area for years at other facilities. While this pressure should ameliorate over time, management should be particularly cognizant of the challenges faced right now by the beamline personnel in assisting users, at the same time as bringing online new capabilities.

SAC notes that there appears to be a healthy oversubscription of beamlines, comparing requested to allocated shifts. Experience at other facilities suggests that these numbers tend to balance out over time, in that groups receiving no allocation after repeated resubmissions will eventually stop submitting proposals. Going forward, it will be important to monitor closely the number of repeat users as this is a strong metric of user satisfaction, since dissatisfied users are more likely to go elsewhere in the long run. While NSLS-II currently is at the forefront of synchrotron radiation facilities, in a few years there will be many alternatives coming on line, even in the USA. As the NSLS amply demonstrated, a strong core of dedicated, competent and well-publishing users are much more likely to return to the facility even when newer facilities are available if they feel that they have been well-served in their experience. It is important to be attentive to building up that loyal core of users even at this early stage.

13. Are the future plans for the respective beamlines appropriate? Are there opportunities we are missing that we should go after? Conversely are any of the beamlines pursuing directions that they should not?

The plans for the further development of the project beamlines are reasonable and sound. Appropriate oversight and guidance should be applied to ensure that the right level of priority is given to these future plans versus continuing with existing capabilities. Fast or slew scanning, improved automation, and more diverse sample environments are common to the future capability of several of the beamlines and these will greatly help in reduction of time in data collection, improve the user experience, and allow more relevant *in situ* experiments to be performed, and are strongly encouraged. The SAC suggests that CSX-2 organize a workshop to better define the needs of the research community for the proposed addition of IRRAS to CSX-2 versus some other potential capabilities.

On a more general level, the SAC observes that the management structure with respect to the user office is at odds with other facilities. The head of the user program has two levels of hierarchy between her and the director. This might isolate the head of the user program from the rest of management. Since users are key to the success of the facility, SAC urges strong connections and communication between the user program and the director. Moreover, there is cause for concern in that the ramp up of the number of users for NSLS-II is projected to be very steep, from 115 unique users in FY15, to 471 in FY16, and a projection of 1415 and 1918 in FY17 and FY18, respectively. This tripling in the number of user, without a concomitant increase in user office personnel, will place great strain on the user office itself, in terms of processing this number of people and providing them with an appropriate level of service.

The SAC members also met with a mixed group of accelerator staff (RF, vacuum) as well as beamline staff. It was re-assuring the note that accelerator staff (RF, vacuum) appear fully

engaged, very motivated, and happy with their work environment. This is a good sign compared to worries expressed by the accelerator physics group members at the last SAC meeting in spring 2016. On the beamline side SAC members noted that staff members at the MX beamlines are very committed, but stressed mostly due to the loss in controls engineers.